Does learning style influence academic performance in different forms of assessment?

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Abstract

Educational research on learning styles has been conducted for some time, initially within the field of psychology. Recent research has widened to include more diverse disciplines, with greater emphasis on application. Although there are numerous instruments available to measure several different dimensions of learning style, it is generally accepted that styles differ, although the qualities of more than one style may be inherent in any one learner. But do these learning styles have a direct effect on student performance in examinations, specifically in different forms of assessment? For this study, hypotheses were formulated suggesting that academic performance is influenced by learning style. Using the Honey and Mumford Learning Style Questionnaire, learning styles of a cohort of first year medical and dental students at Queen's University Belfast were assessed. Pearson correlation was performed between the score for each of the four learning styles and the student examination results in a variety of subject areas (including anatomy) and in different types of assessments – single best answer, short answer questions and Objective Structured Clinical Examinations. In most of the analyses, there was no correlation between learning style and result and in the few cases where the correlations were statistically significant, they generally appeared to be weak. It seems therefore from this study that although the learning styles of students vary, they have little effect on academic performance, including in specific forms of assessment.
Key words: assessment; dental education; learning style; medical education.

Introduction

Educational research has been engaged for some time in investigating the methods by which people learn, an area of great interest to those involved in higher education. Emerging from this was the concept of learning styles, of which there are several forms. Cognitive style (e.g. Riding & Cheema, 1991; Allinson & Hayes, 1996; Rayner & Riding, 1997) refers to how students approach cognitive tasks and 'make sense of their world' (Price, 2004), while learning preferences (e.g. Reichman & Grasha, 1974) refer to how students prefer to be taught. Learning approaches (e.g. Entwistle & Ramsden, 1983) involve how students adopt certain strategies (surface, deep, strategic) when studying, while information processing (learning style) (e.g. Kolb, 1984; Honey & Mumford, 1986) may be defined as how students characteristically approach different learning tasks. Various tools and instruments have been developed in an attempt to measure these (Cassidy, 2004).

Two commonly used questionnaires used to investigate learning styles specifically are Kolb's Learning Styles Inventory (LSI) and Honey and Mumford's Learning Style Questionnaire (LSQ), both derived from Kolb's experiential learning cycle (Kolb, 1984; Honey & Mumford, 1986). The cycle moves through four repeating stages of concrete experience, reflective observation, abstract conceptualisation and active experimentation. The LSI classifies learners according to four learning styles – diverger, assimilator, converger and accommodator, each of which straddles two of the four stages of the learning cycle. Honey & Mumford (1986) modified Kolb's learning cycle, describing the four stages as experiencing, reviewing the experience, concluding from the experience and then planning the next step. They also described four learning styles, but each mainly reflected only one stage of the cycle (Honey & Mumford, 2006). Activists (experiencing) are good at generating ideas, like dramatic changes and excitement and enjoy the limelight; reflectors (reviewing) stand back and observe, watch and think before acting, and prefer investigating without pressure; theorists (concluding) enjoy challenge, probe basic assumptions and like logical, watertight concepts; pragmatists (planning) enjoy techniques with practical value and like learning from demonstration, implementing what has been learnt.

Although it is difficult to compare studies, investigators have attempted to categorise students of specific professions according to the highest attained score in the four domains. Using Kolb's LSI, Cavanagh et al. (1995) in the UK found that there was a fairly even spread between convergers, divergers and accommodators in nursing. French et al. (2007) in Australia found that the greatest percentage of occupational therapists were divergers, and in the USA, Romanelli et al. (2009) found that pharmacists were more commonly accommodators. Medical students tested by Gurpinar et al. (2011) in Turkey were found to be predominantly assimilators. Other investigators have used Honey and Mumford's LSQ to find that medical students tend to be reflectors or activists (V. Haley and C.F. Smith, personal communication), and that nursing students were most commonly reflectors (Fleming et al. 2011). Our own experience of medical and dental students in Northern Ireland is that over a period of 3 years, the scores for the LSQ have consistently been, from highest to lowest, reflector – theorist – pragmatist – activist.

Some researchers have also investigated the influence of learning style on performance in assessment. Haley & Smith (2005) found in their cohort of medical students that theorists were more successful in the end of year examination. Although Gurpinar et al. (2010) found trends in academic performance of medical students with different learning styles in examinations after both lecture-based and Problem Based Learning, their results were not statistically significant. Fleming et al. (2011) carried out 20 comparisons between learning styles and different types of assessment in first and third year nursing students, with the only significant result being a correlation between pragmatists and good first year assignment results, leading them to question whether learning styles are accurate predictors of academic performance.

This study was designed to investigate the learning styles of first year medical and dental students at Queen's University Belfast and to find out whether these have any influence on academic performance, specifically in different types of assessment.

The medical and dental curricula at Queen's University Belfast are designed according to the principles of Guided Discovery (Spencer & Jordan, 1999). This model follows an integrated systems based approach and is outcome driven. The key pedagogic characteristics include a combination of traditional teaching approaches, more innovative tutorials and group learning activities integrated with self-directed learning opportunities. To facilitate learner engagement, clinical case scenarios are used to highlight integration across disciplines and relate theoretical concepts to the workplace.

The modules of the course with an anatomical component include two first year, first semester foundation modules that introduce the students to basic anatomical and histological concepts, facts and vocabulary. The learning opportunities include a mix of whole cohort lectures with self-directed practical microscopy or gross anatomy sessions where students work through material in small groups. A third module held in the second semester of the first year is a largely topographical anatomy module covering the respiratory, circulatory, renal and reproductive systems, with some histological components. It is overwhelmingly practical based and includes dissection of the thorax, renal tract, and the male and female reproductive systems.

According to Honey & Mumford (2006), pragmatists react positively to action learning, small group discussions and task-oriented group work with applied learning. These descriptions could all be applied to anatomical dissection and practical histology sessions, so it might be expected that pragmatists do well in modules emphasising this type of learning.

To carry out the study, three hypotheses were formulated:

1 Overall academic performance is influenced by learning style.
2 Academic performance in different forms of assessment is influenced by learning style.
3 Students with high pragmatist scores perform well in modules with a large practical component (such as topographical anatomy).

Materials and methods

The LSQ was distributed at the beginning of the 2010–2011 academic year to 276 first year medical (226) and dental (50) students attending Queen's University Belfast. Most of the students were school leavers, while 35 were graduates. The mean age of the students taking part in the study was 19.5 years, with 60% being female and 40% male. The questionnaires were then analysed and scored for each of the four learning styles (activist, reflector, theorist and pragmatist, each measured on a 0–20 scale, 20 being the highest).

At the end of the academic year, the results of the summative assessments completed by the students during the year were obtained and compared with their learning style scores. Table 1 shows the types of assessment in the eight examinations used in this study – multiple choice questions of the one of five single best answer variety (MCQs), short answer questions (SAQs) and Objective Structured Clinical Examinations (OSCEs). Where there were too few examination questions for analysis (e.g. MCQs in Module 19, number of items = 30), data were used only for the combined analyses. The modules with an anatomical component were Modules 14, 15 (introductory histological and anatomical elements) and 16 (largely topographical anatomy). Analysis was also done on a written histological specimen report that formed part of the assessment in Module 14. The assessments for Modules 16 and 18 included only the medical students.

For each learning style, a Pearson correlation coefficient was calculated against the examination results at two levels: first, between the learning style scores and the mark for each assessment component of each examination (15 in all); and second, between learning style score and the mark for all the MCQs combined, all the SAQs combined and for the OSCE.

Table 1 Modules carried out during the first year of medicine and dentistry, indicating types of assessment used in the examinations (Mod = module).

Module	Name	MCQ	SAQ	OSCE
Mod13	Genes, Molecules and Processes	✔	✔	
Mod14	Cells, Tissues and Organisms		✔	
Mod15	Systems, People and Populations	✔	✔	
Mod16	Anatomical Basis of Clinical Practice		✔	
Mod17	Physiological Basis of Clinical Practice	✔		
Mod18	Clinical Skills			✔
Mod19	Principles of Disease and Treatment	✔	✔	
Mod20	Concepts, People and Populations		✔	

For all analyses, a *P*-value below 0.05 was regarded as statistically significant.

Ethical approval for the study was given by the Joint Research Ethics Committee of the School of Medicine, Dentistry and Biomedical Sciences at Queen's University Belfast. The students all signed individual consent forms and were made fully aware that participation in the study was voluntary, that they could withdraw at any time, and that taking part would not affect their career progression in any way.
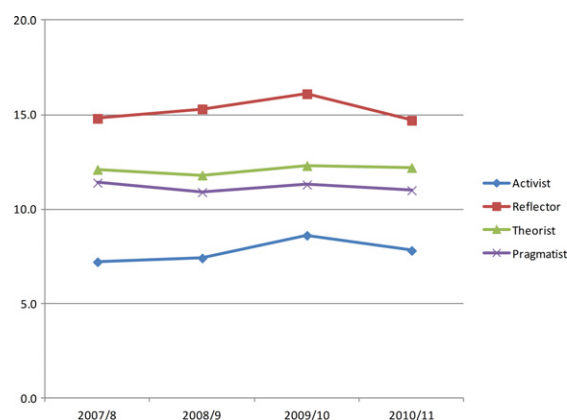
Results

Of the 276 students in first year medicine and dentistry, 260 (94%) completed the LSQ. The dominant learning style score for the students was reflector (mean 14.7, SD ± 3.4), followed by theorist (12.2 ± 2.9), pragmatist (11.0 ± 2.9) and activist (7.8 ± 3.0). This followed the same pattern as previous years (Fig. 1).

The data were also analysed so that the learning style of each student was assumed to be that of the style that gained the highest score. The overwhelming majority of students (65%) were reflectors, followed by theorists (11%) and then pragmatists and activists (each 6%).

There was a positive correlation (*P* < 0.01) between the results of every component of every examination. Students who did well (or poorly) in one assessment were likely to do well (or poorly) in all the others, regardless of type of assessment.

MCQs

Correlations of MCQ results for the three modules including this type of assessment against learning style score are given in Table 2.

Fig. 1 Learning style scores of first year medical and dental students over 4 years.

SAQs

Correlations between SAQ results for the five modules including this type of assessment against learning style score are given in Table 3.

Combined

Correlations of learning style scores against all MCQ exams combined, all SAQ exams combined, the OSCE assessment and the specimen report are shown in Table 4.

Discussion

The learning style scores across the cohort seemed to be remarkably consistent with previous first year students, despite changes in the demographic, with a gradual increase in number of graduate students in the class. At least in this university, selection appears to favour students with high reflector or theorist and low activist scores. This can be compared with the study by V. Haley and C.F. Smith (personal communication) from Southampton, who found that their medical students tended to be reflectors, similar to this study, but also activists, which is in contrast. They did, however, analyse their data differently in that they took the learning style of a student to be that with the highest score, whereas in this study, the individual score for each of the four categories of learning style was considered. Analysis of the data from this study using the same method as V. Haley and C. F. Smith (personal communication) and Haley & Smith (2005) classifies the overwhelming majority of students as reflectors, followed by theorists and finally pragmatists and activists. The difference in the cohorts from the two universities may be a result of this study including dental students and also of the admissions criteria used at each institution. Southampton follows a case-based curriculum, whereas that of Queen's is integrated.

The main aim of this study was to determine whether learning style influences performance in assessments, and

Table 2 Correlations (R) between learning style scores and marks in MCQ components of individual examinations (Mod = module, NS = not significant).

MCQ	Activist		Reflector		Theorist		Pragmatist	
	R	P	R	P	R	P	R	P
Mod13	0.05	NS	0.11	NS	0.18	0.004	0.17	0.007
Mod15	−0.12	0.048	0.12	NS	0.11	NS	0.03	NS
Mod17	0.06	NS	−0.02	NS	0.12	NS	0.12	NS

Table 3 Correlations (R) between learning style scores and marks in SAQ components of individual examinations (Mod = module, NS = not significant).

SAQ	Activist		Reflector		Theorist		Pragmatist	
	R	P	R	P	R	P	R	P
Mod13	−0.07	NS	0.09	NS	0.14	0.029	0.10	NS
Mod14	−0.12	NS	0.09	NS	0.14	0.030	0.07	NS
Mod15	−0.16	0.013	0.10	NS	0.03	NS	0.03	NS
Mod16	−0.05	NS	0.11	NS	0.09	NS	0.07	NS
Mod20	−0.05	NS	0.01	NS	0.06	NS	0.02	NS

Table 4 Correlations between learning style scores and marks in all MCQs and SAQs across assessments combined, in the OSCE and in the histological report (Mod = module, Spec = specimen, NS = not significant).

Combined	Activist		Reflector		Theorist		Pragmatist	
	R	P	R	P	R	P	R	P
MCQ	−0.04	NS	0.14	0.029	0.17	0.006	0.12	NS
SAQ	−0.07	NS	0.07	NS	0.07	NS	−0.04	NS
OSCE	−0.06	NS	0.06	NS	−0.02	NS	−0.09	NS
Spec report	−0.14	0.026	0.15	0.014	0.16	0.009	0.02	NS

specifically in different types of assessment. In the majority of the 15 assessments tested, correlations between marks and learning style scores were not significant. The learning style associated with the greatest number of significant positive correlations was theorist, so there is some suggestion that this learning style may be beneficial in first year medical examinations, a finding supported by the work of V. Haley and C. F. Smith (personal communication). Theorists tend to think things through carefully, enjoying the process of analysing and synthesising material, so it is perhaps not surprising that they may do well in examinations. The assessment methods employed support the use of this learning style. The application of other learning styles, for example reflection, is not readily assessed by these knowledge-based assessment strategies. To date, studies have focused on the relationship between learning styles and performance in exams. However, very little is known about the impact that assessment strategies may have on the learning styles.

Correlations between high activist scores and examination marks tended to be negative, which suggests that high activist scores are not favourable for the assessments analy-sed in this study. These learners prefer to be active, enjoying new experiences and altering activities regularly, so perhaps they are less suited for the steady application of solitary work necessary for good examination results in first year medicine and dentistry. However, more evidence would be needed, as most of the correlations were not significant. Also, the only two significant negative correlations were from the same module, so it might be that this particular subject matter (i.e. sociology and statistics) was less interesting to activists.

Although not the main focus of this study, there was a positive correlation ($P < 0.01$) between student marks in every module. This demonstrates, as expected, that student performance across modules is generally consistent.

There was no correlation between high pragmatist scores and examination results for the module with a large component of anatomical dissection (Module 16). Thus it appears that this learning style, despite seeming to lend itself to the practical group work associated with dissection, is not associated with improved results. There was some indication of an association between high theorist or

reflector scores and writing a histological specimen report. Theorists enjoy exercises with a definitive answer, while both learning styles react well to self-directed learning, qualities that are likely to be important for this type of assessment.

Some criticism has been levelled at the concept of learning styles in recent years, not helped by the plethora of definitions and psychometric instruments used to measure the wide range of dimensions described, with little coherence or commonality (Cassidy, 2004; Cuthbert, 2005). Coffield et al. (2004) highlight the diverse academic underpinnings of learning styles research, which incorporates concepts from three approaches – theoretical, pedagogical and commercial. A further limitation of this type of research is the large number of studies based on small study populations (Cook, 2005). According to Coffield et al. (2004) only a small number of available instruments meet the minimum psychometric criteria of internal consistency, test re-test reliability, construct validity and predictive validity. The Honey and Mumford Learning Styles Questionnaire satisfies one of these criteria – test re-test reliability. Therefore more work needs to be done to find repeatable, consistent and useful measurements with practical applications.

Like Fleming et al. (2011), this study has not found strong evidence of learning styles influencing examination results, so the hypotheses formulated were not accepted. Further research is also required to determine the impact that different assessment methods have on learners' engagement with the various learning styles and to investigate whether students with different learning styles are equally receptive to different teaching styles.

Conclusion

Although correlations between learning style and type of assessment were statistically significant in some cases, they generally appeared to be weak, and in most assessments there was no correlation. Therefore the three hypotheses formulated at the beginning of the project were not accepted and the conclusions for this study are the following:

1 Overall academic performance is not influenced by learning style.
2 Academic performance in different forms of assessment is not influenced by learning style.
3 Students with high pragmatist scores do not perform better in modules with a large practical component such as topographical anatomy.

Author contributions

Tracey Wilkinson was responsible for the concept and the writing of the manuscript. Mairead Boohan collected the learning style data, and Mike Stevenson conducted the statistical analysis. All authors developed the concept and reviewed the manuscript.

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